The Oil Drum
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Environmental Impacts of Oil Sands Development in Alberta

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The following is a guest post by Simon Dyer, of Canada's Pembina Institute. The Pembina Institute believes that while oil sands extraction has many issues, it can be done in an environmentally sustainable way. In the end, they advocate a moratorium on new project approvals until 2011, new regional environmental groups and some additional environmental controls, as described in their publication Taking the Wheel. Increased CO2 emissions might be handled through purchase of carbon emissions credits and through improvements in production efficiency. While the oil sands aren't great, with some adjustments, they may still be an acceptable solution. The comments to this post are helpful in understanding the complex situation. Don't miss them!

By Simon Dyer, Oil Sands Program Director,
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The oil sands are an issue of global importance. As conventional sources of crude oil are depleted, unconventional sources of oil, such as the bitumen found in oil sands, play a larger role in offsetting declining conventional production. The Canadian oil sands are the second largest proven oil reserve after Saudi Arabia.[1]

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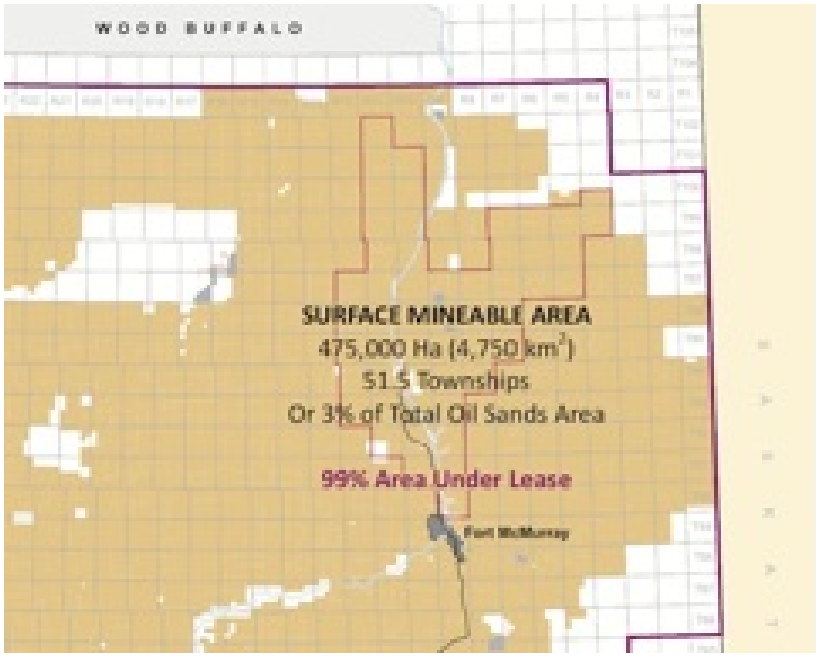
Most of the Canadian oil sands are located in Alberta, with 175 billion barrels of recoverable bitumen underlying approximately 140,800 square kilometres of the province,[2] an area that is

roughly the size of the state of Florida. This unconventional oil is currently extracted using surface mining or in situ (in place) drilling methods, depending on the depth of the deposit. Mining is used for the bitumen that is closer to the surface (less than 75 metres), and drilling for in situ extraction is used when the bitumen is more than 75 metres deep.[3] Each extraction method presents its own challenges.

As the rate and scale of oil sands development increases, concerns about the associated environmental impacts have grown. The Pembina Institute has been reporting on these concerns and providing factual information on the environmental impacts since the release of its Oil Sands Fever report in 2005.

To fully understand the costs and benefits of the oil sands requires more than an appreciation of the size of the resource and the financial rewards of exploiting it. An understanding of the environmental effects and the context of a growing global imperative to reduce our global carbon footprint is essential. The Pembina Institute's work is designed to help policy makers and others guide energy development with eyes wide open and with a clear idea of the challenges that need to be overcome to achieve responsible development of the Alberta oil sands.



About 99% of the mineable oil sands area has been leased. Source: Alberta Energy (Click for more detailed view).

The oil sands underlie 140,800 square kilometres, or 21% of the province of Alberta. Updated figures from the Alberta government's Department of Energy show that the mining portion of this land base will be approximately 4,750 square kilometres, and that 99% of the mineable area has already been leased.[4]

About 4,750 square kilometres of land has been leased to oil sands mining operations, such as Suncor (right side of photo) and Syncrude (top left of photo). Photo: David Dodge, The Pembina Institute

In situ development could occur in an area approximately 30 times greater than the mining area. This type of development creates significant linear disturbance to the boreal forest. These linear disturbances, from seismic and core hole exploration, production well pads, roads and pipelines, can negatively impact species of wildlife that avoid linear features, such as the endangered woodland caribou.[5]

Mining extraction currently accounts for 60%[6] of the 1.4 million barrels of bitumen produced each day.[7] In situ development represents the most significant growth potential for the oil sands industry and will contribute a growing proportion of future oil sands production. For more information about in situ development see Pembina's report Death by a Thousand Cuts: The Impacts of In Situ Oil Sands Development on Alberta's Boreal Forest.

In situ oil sands development imposes a unique set of impacts on the boreal forest, such as this 3D seismic work to map the oil sands resource south of Fort McMurray, Alberta. Photo: David Dodge, The Pembina Institute.

Since development began around 40 years ago, 84,000 square kilometres of land underlain with oil sands deposits has been leased in Alberta, accounting for about 60% of the total resource area.[8] Lands are leased to companies with no environmental impact assessments or consultation with stakeholders (including Aboriginal groups). This part of the process does not take place until the project application phase of development. To learn more about how the Alberta Government grants oil sands rights to companies see Haste Makes Waste: The Need for a New Oil Sands Tenure Regime.

Reclamation of boreal forest lands after development is quite a challenge for the industry, and the boreal ecosystem will never be fully restored. While wetlands occupy about 40-50% of the landscape before development, reclamation projects are returning the landscape to a predominantly upland, forested ecosystem. Reclamation of peatland (a type of wetland) ecosystems is still undemonstrated.

Companies are required by the Alberta government to post a security deposit as insurance in the event of unforeseen events or in the case of bankruptcy.[9] This reclamation security is likely inadequate to protect Canadians from long-term environmental liabilities. Recommendations by the Auditor General of Alberta to review the reclamations security program have not been heeded by government. More information can be found in the report Fact or Fiction: Oil Sands Reclamation.

Carbon Intensity

Greenhouse gas emissions are higher for oil sands production than for conventional oil production. Photo: David Dodge, The Pembina Institute

Oil sands development is carbon-intensive. The production and upgrading required to produce synthetic crude oil from oil sands mining results in greenhouse gas emissions in the range of 62 to 164 kilograms of CO2 equivalent per barrel. In situ development, which is generally more carbon-intensive than mining, results in emission rates between 99 and 176 kilograms of CO2 equivalent per barrel.[10] Although there is a high degree of variation, industry average emissions for oil sands production and upgrading are estimated to be 3.2 to 4.5 times as intensive per barrel as conventional crude produced in North America.[11] Canadian government reports similarly suggest that "GHG emissions from oil sands mining and upgrading are about five times greater than those from conventional light/medium crude oil production."[12] Even if you look at it from a full life-

cycle “well-to-wheels” basis, oil sands are overall still one of the most greenhouse gas intensive fuel sources.[13]

While Canada was one of the 39 industrialized countries that signed on to the Kyoto Protocol in 2002 to reduce its national greenhouse gas emissions to 6% below 1990 levels,[14] it has since backed down from these obligations. Canada has earned the reputation of being obstructionist to international climate change negotiations as we approach the Copenhagen summit.[15] More on this topic can be found in the report: The Climate Implications of Canada’s Oil Sands Development and Carbon Capture and Storage in Canada.

Water Use

Producing a barrel of synthetic crude oil from the oil sands by mining requires two to four barrels of fresh water after taking into account water recycling.[16] Companies are currently licensed to withdraw over 590,000,000 cubic metres of water per year, which is roughly equivalent to what a city of 3 million people would require.[17] Water for oil sands mining is pumped from the Athabasca River, a river that fluctuates seasonally as well as year to year, and withdrawing water during natural low flow periods (which occur primarily in the winter) has the potential to harm aquatic life in the river.[18] This water cannot be returned to the river system because it becomes toxic in the extraction process and must be retained in tailings ponds.

In situ development is less water intensive at approximately 0.9 barrels of water per barrel of oil, yet this is still higher than water use for conventional oil production, which averages 0.1-0.3 barrels of water per barrel of oil.[19] In situ operations produce steam from fresh and saline water sources that is then injected to “help reduce the viscosity" (melt) the bitumen in the reservoir so it can be pumped out. Wastewater produced by in situ development is not contained in tailings ponds, but rather injected into deep aquifers on site.[20] See Down to the Last Drop: The Athabasca River and Oil Sands and Troubled Waters, Troubling Trends for more information on water in the oil sands.

Tailings

This tailings pond is about five kilometers long and is located to the north of the Syncrude oil sands operation. Photo: David Dodge, The Pembina Institute

The liquid tailings, a by product of the oil sands mining process, contain naphthenic acids, unrecovered hydrocarbons and trace metals, making it toxic to aquatic organisms[21] and mammals[22].

Operators are required to store tailings waste on site in large containment dykes because the water is too toxic to be returned to the Athabasca River under water quality guidelines.

There are currently over 720 billion litres of toxic tailings on the landscape in the Athabasca oil sands area.[23] These ponds cover an area of more than 130 square kilometres. By 2040 these tailings are expected to occupy 310 square kilometres, an area nearly the size of Vancouver.[24] No tailings ponds have been reclaimed to date. More information on tailings and reclamation can be found in Pembina's report Fact or Fiction: Oil Sands Reclamation.

One of the major concerns associated with tailings ponds is the migration of pollutants through the groundwater system, which can in turn leak into surrounding soil and surface water.[25] There is currently a lack of publicly available information on the rate and volume of seepage from oil sands tailings ponds, despite known incidents involving tailings seepage.[26]

A dominant plan for reclaiming liquid tailings at mine closure is to deposit them in end pit lakes. Tailings would be dumped into old mine pits and capped with water from the Athabasca River.[27] This method is unproven. The concern is that the water and tailings layers will mix and there is also some fear that the end pit lakes will be unable to sustain aquatic life. However, many mining projects to date have been approved based on dealing with tailings in this manner. A fully realized end pit lake has not yet been constructed.[28]

Cumulative impacts

Since 2000, environmental and cumulative effects management in the oil sands has relied heavily on multi-stakeholder groups such as the Cumulative Effects Management Association (CEMA). CEMA has had troubles meeting goals within its own work plan, which has been largely attributed to a lack of resources and a lack of regulatory backstops from the Government of Alberta.[29]

The Pembina Institute recently released a report on how mining companies scored relative to one another in various categories. The report Under-Mining the Environment: The Oil Sands Report Card ultimately showed the improvements that could be made if each company performed at the level of the current highest achiever in that specific category. While many improvements could be made, having regulatory backstops at the level of current best practices would be a means to reduce cumulative impacts in the oil sands area.

Oil sands projects continue to get approved and begin construction in northeastern Alberta, in spite of there being very few limits set for water, air, land or toxins. This situation, combined with the lack of a land use plan, creates uncertainty about what the final landscape in the oil sands area will look like once development in the area is operating fully. It also calls into question what the development area will look like once development is finished. The Pembina Institute gives its recommendations for environmental management in Taking the Wheel: Correcting the Course of Cumulative Environmental Management in the Athabasca Oil Sands.

Notes:

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13. Kristin J. Gerdes and Timothy J. Skone, *An Evaluation of the Extraction, Transport and Refining of Imported Crude Oils and the Impact on Life Cycle Greenhouse Gas Emissions* (U.S. Department of Energy, National Energy Technology Laboratory, 2009), 16, figure 3-3, http://www.netl.doe.gov/energy-analyses/refshelf/detail.asp?pubID=227.

14. Canada ratified the Kyoto Protocol on December 17, 2002. See http://maindb.unfccc.int/public/country.pl?country=CA.

15. Hannah Devlin, "Canada and Japan blocking climate-change deal, Sir David King warns," *Times Online*, July 2, 2009,

http://www.timesonline.co.uk/tol/news/environment/article6620438.ece (accessed July 8, 2009).

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